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Water Power on the Santiam River

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WATER POWER

ON THE

SANTIAM RIVER

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University of Oregon

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ROCK GORGE AT NIAGARA.

ROCKY GORGE A FEW MILES ABOVE NIAGARA.

Water Power on the Santiam River

EXPLANATORY NOTE.

This Bulletin, No. 1, Vol. II., of the new Series, is the third industrial bulletin issued by the University. The first was entitled "Water Power on the McKenzie River," and contained also "Botanical Notes" gathered by Professor Sweetser at the same time with the hydrographic survey.

The second was entitled "Mineral Resources and Mineral Industries of Oregon," prepared by Professor O. F. Stafford, of the Department of Chemistry. No more copies of the first bulletin remain for distribution, the issue of 700 copies having been exhausted some time since.

In the first bulletin referred to, the announcement was made that the University had entered upon the policy of gathering careful and reliable data as to the industrial resources of the state, and the reasons therefor were set forth at some length. It is unnecessary here to repeat the explanation in full, but the following extract will perhaps be pertinent:

"It is believed that the University, while increasing its store of useful knowledge for the immediate benefit of its courses of instruction, can contribute materially to the industrial development of the state; and this too at a minimum of expense, since it already has an organized corps of men, well trained in their specialties, receiving

a regular salary, and having a very considerable equipment of field instruments, apparatus and laboratory facilities. While it is true that this force is not primarily organized for the purpose of gathering information, it is also true that its organization and equipment are exactly of the kind required for such a purpose, and since no specific organization has been provided in the state, or could be provided without a very large initial outlay, the University feels under obligation to do what its resources will permit, in making the largest possible return to the state for the cost of its equipment and maintenance.

"In a word, then, the policy of the University under which this survey was begun is simply this: To better its courses of instruction for students, and also to serve as helpfully and fully as it may its wider clientele, the citizens of Oregon."

GENERAL DESCRIPTION.

As a part of the general scheme of gathering industrial data, the hydrographic survey herein described was undertaken to investigate the available water power of the Santiam River. This river forms the boundary between the counties of Linn and Marion, and has its source in the snow banks that cover the slopes of Mt. Jefferson, flowing westerly a distance of seventy odd miles to its confluence with the Willamette some eight or ten miles below Albany.

The survey covered a stretch of about 24 miles of the river, from a half mile above the abandoned railroad station Idanha, to Mill City. It is believed that the earliest developments of power on the Santiam are likely to be along the portion surveyed.

For most of the 24 miles, the river flows through a narrow canyon, with only infrequent "flats" of small area—it has nothing that could be called a valley. The slopes of the canyon generally run sheer to the river, without the intervention of any level bottom land such as

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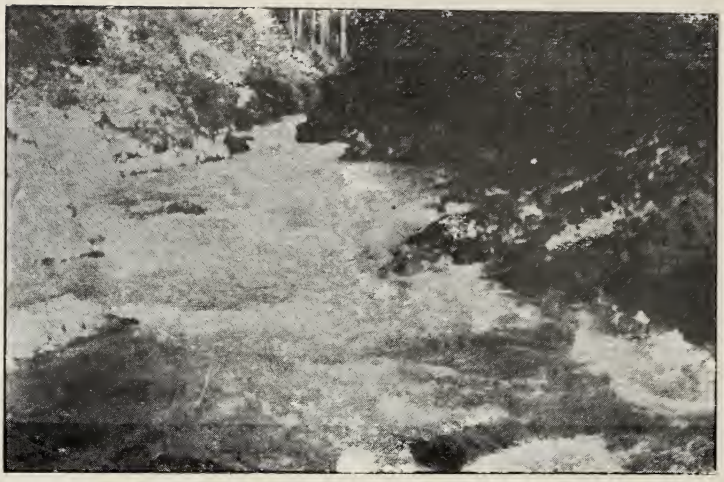
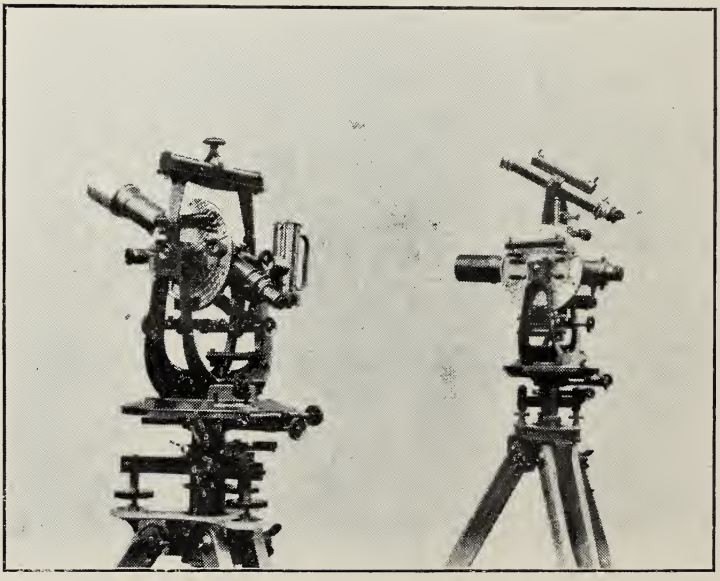


VIEW SHOWING GENERAL CHARACTER OF THE SANTIAM—
ROCKY BANKS AND NARROW CANYON.



TRANSITS USED ON THE SURVEY—THE SECONDARY TELESCOPE ON THE
SMALLER INSTRUMENT IS A SOLAR ATTACHMENT WHICH WAS REMOVED

is usually found along most streams. These slopes are in the main covered with timber, much of it valuable; in fact the lumber industry, with its necessary concomitants, is practically the sole dependence for the support botl. of the population and of the railroad.

With few if any exceptions, the banks of the stream are either solid rock or gravel so firmly cemented with clay and iron that it stands at a nearly vertical slope from 20 to 40 feet in height. Naturally, under these circumstances, the lateral erosion of the stream is small —the river simply cuts its channel deeper without cutting the banks to any considerable extent. It appears probable that in past ages there may have been several falls along this portion of the river, but at the present time the water has cut a narrow, deep and sometimes tortuous channel through the rock. In some of these places the channel is not over 20 feet wide, and in at least one place (at Niagara), it is less than 10 feet wide.

While there are numberless little creeks and rills flowing into the Santiam, the only tributaries of any individual consequence between Idanha and Mill City are the Breitenbush and Blowout Creeks, of which some mention will be made later on.

The survey involved four kinds of work: Leveling, to determine the elevation of the river surface from point to point, the amount of fall between any two points being directly shown by the difference of elevation; a transit traverse, showing the windings of the stream bed and distances along the bank; astronomical observations for the correction of azimuths carried forward by the transit; measurements of the stream flow, or the number of cubic feet of water passing a given section of the river in a second of time. This work was divided as follows: The leveling was done by Mr. C. F. Rhodes, of the class of 1905, assisted by Mr. Carl McClain, '06. The transit traverse was made by Mr. Percy P. Adams, instructor in the Department of Civil Engineering, assisted by Mr.

J. A. Gamber, '02, Registrar of the University, and Mr. A. R. Tiffany, '06. In the stream measurements all members of the party assisted in building rafts, when necessary, stretching the rope across the river, making soundings, etc., while in the velocity measurements, Mr. Rhodes manipulated the current meter, the writer noted the record of the electric sounder and stop watch, and Mr. Adams recorded the results. The astronomical observations were taken at night by the writer, assisted by Mr. Adams. During the day, the writer, as chief of party, exercised general supervision over the entire work and carried on such reconnoissance work as seemed necessary. The task of reducing the field notes and making the necessary calculations was borne chiefly by Mr. Adams, who also drew the map. The methods of field work were substantially the same as described in the appendix to the McKenzie Bulletin, and need not be described here.

RESULTS OF THE SURVEY.

The main results of the survey are shown on the folding map and profile following the text. The profile of the river surface shows the elevations above sea level of the points designated, the elevations being given in feet and tenths. The elevations stated are those obtained at the time of the survey. The actual elevations of course fluctuate with the rise and fall of the river, but for the most part the profile would be parallel to the one given. At times of flood, however, the shape of the profile would be more or less altered, since the river rises most in places where the channel is narrow and confined, while in places where the channel widens out the rise may be several feet less. The fall between any two points may be found from the profile by simply taking the difference

of elevation at those points and the distance along the river may be counted on the vertical lines, which are one mile apart. These distances are the actual distances measured along the winding course of the stream. Corresponding points on the map and profile are marked by consecutive numbers.

Stream measurements were made at three places, the first a half mile above Detroit, the second below the mouth of Blowout Creek, and the third just above Mill City. These measurements consist of soundings taken at intervals across the stream bed, together with measurements of the velocity of the water at numerous points in the cross-section of the stream, the velocities being taken with a standard current meter having an electric attachment to indicate the number of revolutions of the wheel in a given time, noted by a stop-watch. The discharge of the stream at the points mentioned was found to be as follows:

	Cubic feet per second
Above Detroit	1228
Below Blowout Creek	1899
At Mill City	2191

Those who wish to know the flow in miner's inches may multiply the above numbers by 50, obtaining respectively 61,400, 94,950 and 109,550 miner's inches.

As the Breitenbush and Blowout Creek are the principal tributaries between the first and second measurements, it will be seen that these two streams carried together something over 600 cubic feet per second.

These measurements made early in the summer, during the latter half of June, do not represent quite the extreme low water flow of the stream, but they give what may be called the average summer flow; for the Santiam, like other streams fed by eternal snow peaks, does not markedly decrease in flow during the summer, though there is of course a slight diminution.

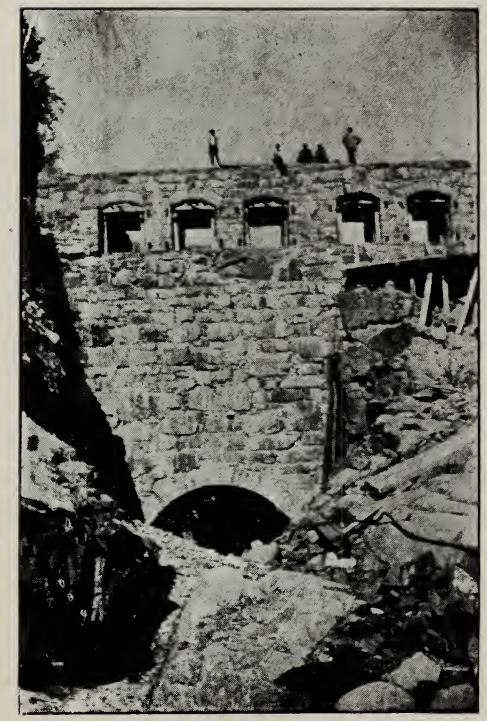
POSSIBILITIES OF THE SANTIAM.

It will be noted from the profile that the total fall of the river in the 24 miles surveyed is nearly 900 feet. This, in connection with the three discharge measurements, shows that the total energy of the stream for the 24 miles is the equivalent in round numbers of 175,000 horse power continuously exerted. It would of course be impracticable to develop the whole of this power, but probably 100,000 horse power could be economically developed in a series of plants varying from 5000 to 10,000 horse power each, or any smaller amount. In one place, at least, a 15,000 horse power plant would be possible.

As to the methods of development, a consideration of the character of the river canyon, as already described, would indicate that canals of any considerable size and length would generally be out of the question, on account of the expense of excavation. Possibly in two or three places canals of moderate length and size might be practical, but certainly such instances are very rare.

For any large plant, a high dam, controlling the entire flow of the stream, would seem to be the best solution. Fortunately, there are several places which are almost ideal dam sites. Unfortunately, some of them cannot be utilized to the full extent of their natural advantages without flooding the railroad and involving a large expense for relocation. This is of course not the fault of the railroad, for like all other railroads, it was laid out to secure the best attainable grades, without reference to the then remote possibility of power development. However, dams of from 30 to 50 feet in height could be constructed without flooding the railroad, and at a very moderate expense, owing to the extreme narrowness of the channel and the solid rock on sides and bottom. Such dams would afford a sufficient head and

ROCK GORGE AND LOG JAM ABOVE
SARDINE CREEK



PORTION OF UNCOMPLETED DAM
AT NIAGARA.

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volume for plants of from 5000 to 8000 or 9000 horse power. At Niagara the height of dam could be about 80 feet without interfering with the railroad, and probably without doing any material damage to other property. This would give a plant of about 15000 horse power. The Niagara site is in many respects not the best one naturally, but it has the advantage mentioned, over sites farther up the river. At several of the sites referred to, the curved or arched type of dam, like the Bear Valley dam in California, would be practicable and effect a great saving of masonry over the ordinary straight type of gravity dam.

For smaller plants, say up to 2000 horse power, either low dams affording a large volume under a small head, or wooden flumes, headed by short diversion canals, affording a smaller volume under a greater head, would seem advisable. The cost of fluming would nowhere be extraordinary, as there is an abundance of timber, saw mills, and a railroad for transportation. For this method of development, reference to the profile will show many stretches where the fall exceeds 40 feet per mile, and in one instance runs up to 70 feet. A list of these places has been prepared, but reference to the profile is so easy that it seems unnecessary to print the list.

Doubtless ingenuity could devise other methods of development than those mentioned, but these seem to be the ones most naturally suggested by the conditions.

Attention should perhaps be called to Blowout Creek as a possible site for a high-head development. This creek is said to come from a lake which is at no great distance from the river, but at a very considerable elevation above the river. Opportunity for an investigation of this matter did not present itself during the course of the survey, nor were the possibilities of the Breitenbush examined.

The only water power development so far existing on this portion of the river is at Mill City, where a short

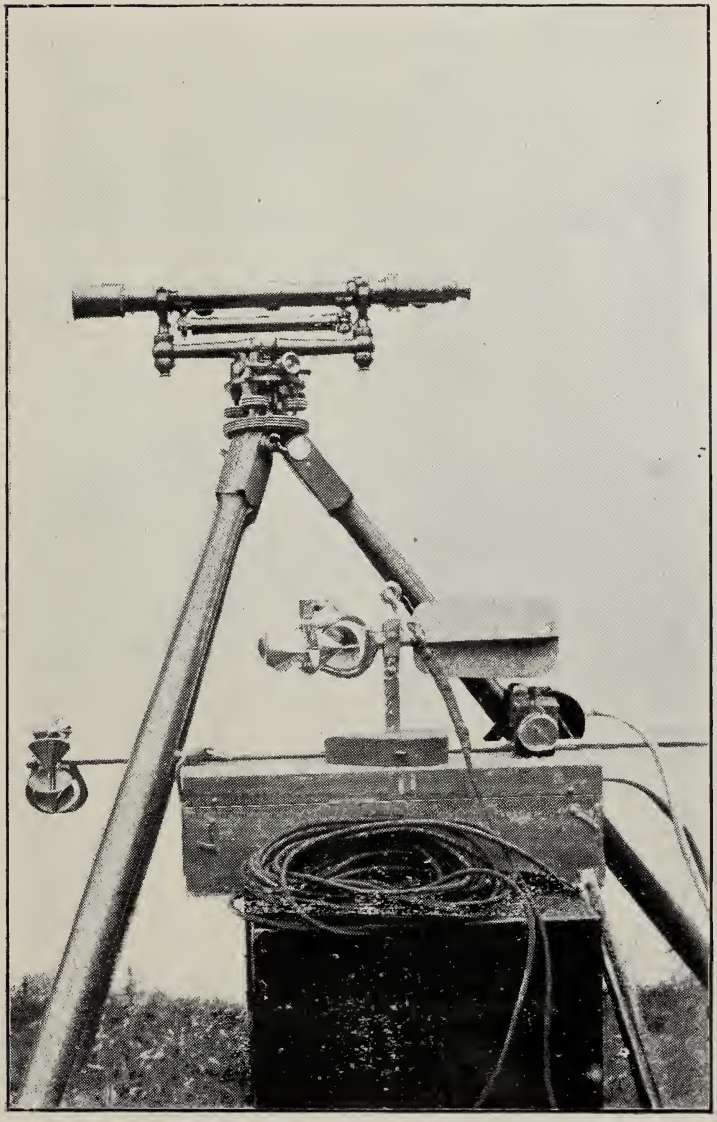
ditch affords power for a saw mill. Some money has been spent at Niagara in constructing a portion of a dam, but the work has been abandoned.

In Bulletin No. 3, some remarks were made as to the possibility of a market for electricity generated by water power at favorable sites and transmitted to the valley. The same remarks apply to the case of the Santiam. Judging from recent developments, the profitable nature of the trolley line appears to be pretty thoroughly appreciated, and doubtless factories operated by electric power generated in the mountain streams will soon follow the trolley. With the abundance of water power which the state possesses, there is small excuse for paying transcontinental freight on manufactured articles.

One other point needs repeated emphasis. The desirability of electric heating along with electric lighting has long been recognized, but so far the appliances seem unsatisfactory. Here is the possibility of an enormous consumption of electricity, and genuine progress in our home life.

Considering the vastness of the possible market, this matter appears not to have received the attention which it deserves, and it would seem desirable for those financially interested to stimulate progress in this line. Our water power can give us cheap electricity in our homes: let the electricians perfect an economical and satisfactory heating appliance.

In concluding this report, it may be said that the Santiam offers many advantages in the way of water power development. Some of these have been set forth, but not the least is the fact that a railroad already runs up the river and would greatly lessen the cost of transportation of machinery, cement and other materials required in the construction of a power plant. Probably there is no other stream in this part of the state where plants of the capacities herein stated could be installed at so low



WYE LEVEL AND CURRENT METERS

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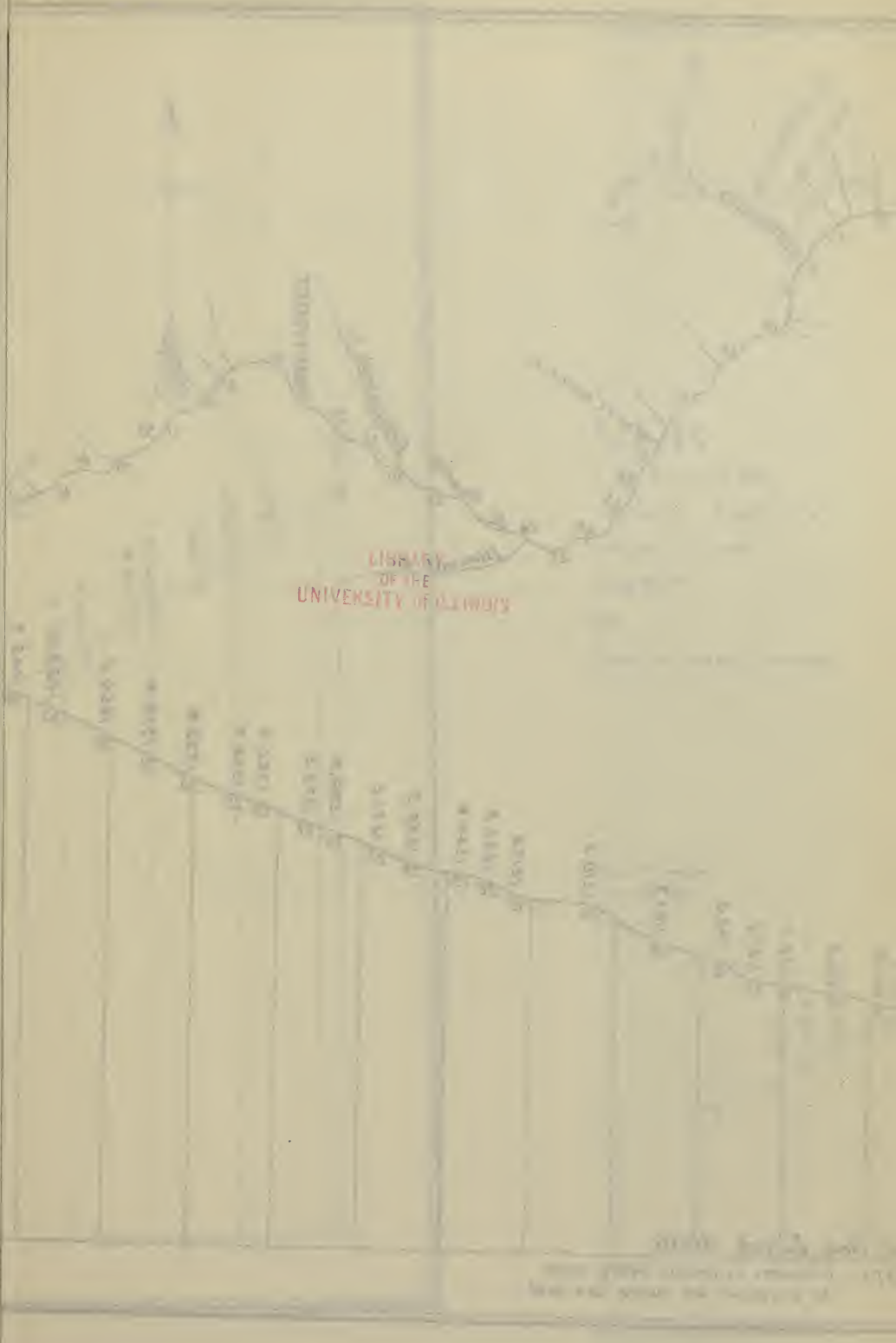
a cost. In the future progress of the middle Willamette Valley the water power of the Santiam, electrically transmitted, is bound to prove an important factor.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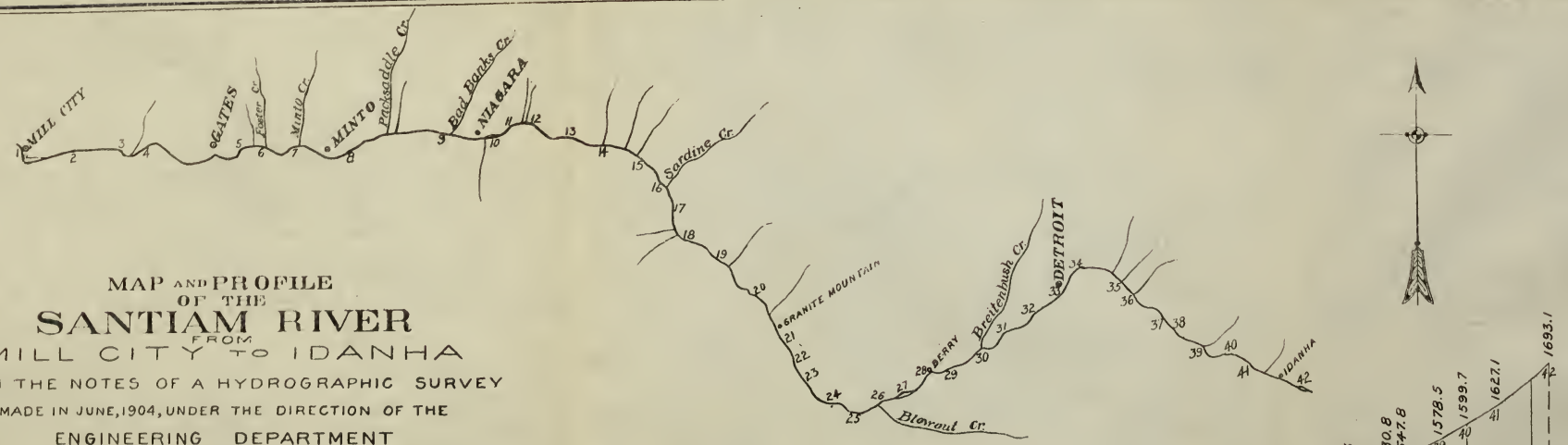


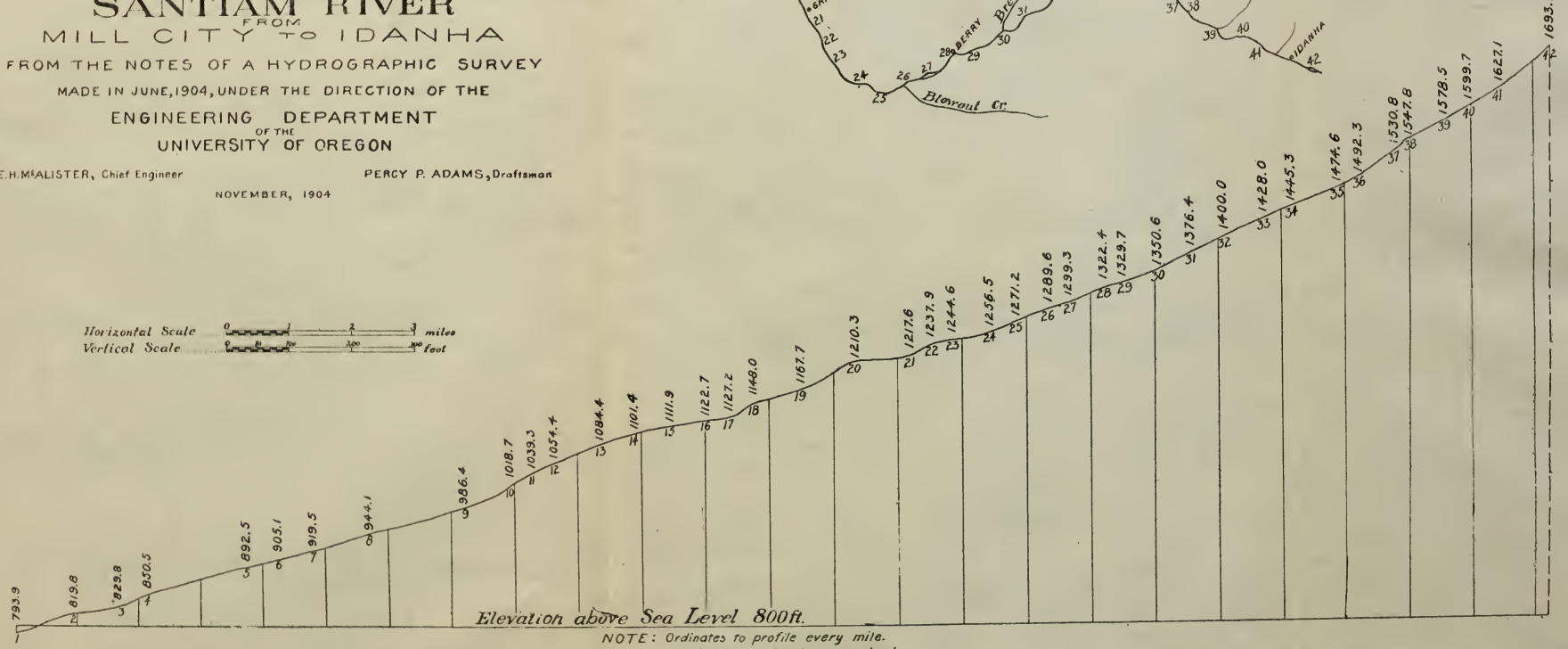
MAP AND PROFILE OF THE SANTIAM RIVER FROM MILL CITY TO IDANHA

FROM THE NOTES OF A HYDROGRAPHIC SURVEY MADE IN JUNE, 1904, UNDER THE DIRECTION OF THE ENGINEERING DEPARTMENT OF THE UNIVERSITY OF OREGON

E.H. McALISTER, Chief Engineer

PERCY P. ADAMS, Draftsman

NOVEMBER, 1904



NOTE: Ordinates to profile every mile.
All elevations are above sea level.

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